CLAIMS

We claim:

1. A method for generating a digital image indicative of an internal anatomy of a person over a respiratory cycle, comprising:

scanning the internal anatomy of the person at a plurality of positions along an axis to obtain scanning data, wherein the scanning at each position is performed over at least one respiratory cycle of the person;

generating a plurality of cross-sectional digital images based on the scanning data;

generating a plurality of cross-sectional digital image groups, each group comprising at least two digital images of the plurality of cross-sectional digital images wherein each of the two digital images indicate the internal anatomy at a substantially similar respiratory state;

generating a plurality of 3-D digital images, wherein each digital image of the plurality of 3-D digital images is determined from a corresponding one of the plurality of cross-sectional digital image groups; and

processing the plurality of 3-D digital images to obtain a resultant 3-D digital image indicating positions of at least a portion of the internal anatomy of the person during at least the respiratory cycle.

2. The method of claim 1, wherein the processing of the plurality of 3-D digital images comprises:

performing a minimum intensity projection of the plurality of 3-D digital images to obtain the resultant 3-D digital image.

3. The method of claim 2, wherein the resultant 3-D digital image comprises a first region having a first plurality of voxel intensity values indicative of a tumor and a second region having a second plurality of voxel intensity values indicative of the internal anatomy surrounding the tumor, wherein each of the first plurality of voxel intensity values are less than each of the second plurality of voxel intensity values.

4. The method of claim 1, wherein the processing of the plurality of 3-D digital images comprises:

performing a maximum intensity projection of the plurality of 3-D digital images to obtain the resultant 3-D digital image.

5. The method of claim 4, wherein the resultant 3-D digital image comprises a first region having a first plurality of voxel intensity values indicative of a tumor and a second region having a second plurality of voxel intensity values indicative of the internal anatomy surrounding the tumor, wherein each of the first plurality of voxel intensity values are greater than each of the second plurality of voxel intensity values.

6. The method of claim 1, wherein the processing of the plurality of 3-D digital image comprises:

performing an average intensity projection of the plurality of 3-D digital images to obtain the resultant 3-D digital image.

7. The method of claim 1, wherein processing the plurality of 3-D digital images to obtain the resultant 3-D digital comprises:

performing a maximum intensity projection of the plurality of 3-D digital images to obtain a first 3-D digital image;

generating a boundary within the first 3-D digital image around a predetermined portion of the internal anatomy of the person;

performing a minimum intensity projection of the predetermined portion of the first 3-D digital image to obtain a second 3-D digital image; and

combining the first 3-D digital image and the second 3-D digital image to obtain the resultant 3-D digital image.

8. The method of claim 7, wherein the resultant 3-D digital image comprises a first region having a first plurality of voxel intensity values indicative of locations of a tumor during at least one respiratory cycle and a second region having a second plurality of voxel intensity values indicative of the internal anatomy surrounding the tumor, the first plurality of voxel intensity values being greater than each of the second plurality of voxel intensity values.

9. The method of claim 7, further comprising:

color coding a portion of the resultant 3-D digital image; and

displaying the color-coded resultant 3-D digital image on a display monitor.

10. The method of claim 7, further comprising displaying the resultant 3-D digital image on a display monitor using a volume rendering technique.

11. The method of claim 7, further comprising storing the resultant 3-D digital image in a memory.

12. The method of claim 1, wherein processing the plurality of 3-D digital images to obtain the resultant 3-D digital comprises:

performing a minimum intensity projection of the plurality of 3-D digital images to obtain a first 3-D digital image;

generating a boundary within the first 3-D digital image around a predetermined portion of the internal anatomy of the person;

performing a maximum intensity projection of the predetermined portion of the first 3-D digital image to obtain a second 3-D digital image; and

combining the first 3-D digital image and the second 3-D digital image to obtain the resultant 3-D digital image.

13. The method of claim 12, wherein the resultant 3-D digital image comprises a first region having a first plurality of voxel intensity values indicative of locations of a tumor during at least one respiratory cycle and a second region having a second plurality of voxel intensity values indicative of the internal anatomy surrounding the tumor, the first plurality of voxel intensity values being less than each of the second plurality of voxel intensity values.

14. The method of claim 12, further comprising:

color coding a portion of the resultant 3-D digital image; and

displaying the color-coded resultant 3-D digital image on a display monitor.

15. The method of claim 12, further comprising displaying the resultant 3-D digital image on a display monitor using a volume rendering technique.

16. The method of claim 12, further comprising storing the resultant 3-D digital image in a memory.

17. The method of claim 1, wherein scanning the internal anatomy of the person comprises monitoring a position on a chest of the person during respiration by the person to determine the time period of the respiratory cycle of the person.

18. The method of claim 1, wherein the at least a portion of the internal anatomy of the person comprises a tumor.

19. The method of claim 1, wherein the plurality of cross-sectional digital images comprises a plurality of computerized tomography images.

20. The method of claim 1, wherein the plurality of cross-sectional digital images comprises a plurality of magnetic resonance images.

21. The method of claim 1, wherein the plurality of 3-D digital images comprises a plurality of 3-D computerized tomography images.

22. The method of claim 1, further comprising displaying at least a portion of the resultant 3-D digital image on a display monitor.

23. The method of claim 1, further comprising displaying a 2-D portion of the resultant 3-D digital image on a display monitor.

24. The method of claim 1, further comprising:

color coding a portion of the resultant 3-D digital image; and

displaying the color-coded resultant 3-D digital image on a display monitor.

25. The method of claim 24, wherein the color-coded resultant 3-D digital image is generated using a volume rendering display technique.

26. A system for generating a digital image indicative of an internal anatomy of a person over a respiratory cycle, comprising:

a respiratory monitoring device generating a first signal indicative of a respiratory state of the person;

a scanning device configured to scan an internal anatomy of the person to obtain scanning data; and

a computer operably coupled to both the respiratory monitoring device and the scanning device, the computer configured to generate a plurality of cross-sectional digital images based on the scanning data, the computer further configured to generate a plurality of cross-sectional digital image groups, each group comprising at least two digital images of the plurality of cross-sectional digital images wherein each of the two digital images indicate the internal anatomy at a substantially similar respiratory state, the computer further configured to generate a plurality of 3-D digital images, wherein each digital image of the plurality of 3-D digital images is determined from a corresponding one of the plurality of cross-sectional digital image groups, the computer further configured to process the plurality of 3-D digital images to obtain a resultant 3-D digital image indicating positions of at least a portion of the internal anatomy of the person during at least the respiratory cycle.

27. The system of claim 26, wherein the computer being further configured to process the plurality of 3-D digital images, comprises:

the computer being configured to perform a minimum intensity projection of the plurality of 3-D digital images to obtain the resultant 3-D digital image.

28. The system of claim 27, wherein the wherein the resultant 3-D digital image comprises a first region having a first plurality of voxel intensity values indicative of a tumor and a second region having a second plurality of voxel intensity values indicative of the internal anatomy surrounding the tumor, wherein each of the first plurality of voxel intensity values are less than each of the second plurality of voxel intensity values.

29. The system of claim 26, wherein the computer being further configured to process the plurality of 3-D digital images, comprises:

the computer being configured to perform a maximum intensity projection of the plurality of 3-D digital images to obtain the resultant 3-D digital image.

30. The system of claim 29, wherein the resultant 3-D digital image comprises a first region having a first plurality of voxel intensity values indicative of a tumor and a second region having a second plurality of voxel intensity values indicative of the internal anatomy surrounding the tumor, wherein each of the first plurality of voxel intensity values are greater than each of the second plurality of voxel intensity values.

31. The system of claim 26, wherein the computer being further configured to process the plurality of 3-D digital images, comprises:

the computer being configured to perform an average intensity projection of the plurality of 3-D digital images to obtain the resultant 3-D digital image.

32. The system of claim 26, wherein the computer being further configured to process the plurality of 3-D digital images, comprises:

the computer being configured to perform a maximum intensity projection of the plurality of 3-D digital images to obtain a first 3-D digital image;

the computer being further configured to generate a boundary within the first 3-D digital image around a predetermined portion of the internal anatomy of the person;

the computer being further configured to perform a minimum intensity projection of the predetermined portion of the first 3-D digital image to obtain a second 3-D digital image; and

the computer being further configured to combine the first 3-D digital image and the second 3-D digital image to obtain the resultant 3-D digital image.

33. The system of claim 32, wherein the resultant 3-D digital image comprises a first region having a first plurality of voxel intensity values indicative of locations of a tumor during at least one respiratory cycle, and a second region having a second plurality of voxel intensity values indicative of the internal anatomy surrounding the tumor, the first plurality of voxel intensity values being greater than each of the second plurality of voxel intensity values.

34. The system of claim 32, wherein the computer is further configured to color code a portion of the resultant 3-D digital image and to display the color-coded resultant 3-D digital image on a display monitor.

35. The system of claim 32, further comprising displaying the resultant 3-D digital image on a display monitor using a volume rendering technique.

36. The system of claim 32, further comprising storing the resultant 3-D digital image in a memory.

37. The system of claim 26, wherein the computer being further configured to process the plurality of 3-D digital images, comprises:

the computer being configured to perform a minimum intensity projection of the plurality of 3-D digital images to obtain a first 3-D digital image;

the computer being further configured to generate a boundary within the first 3-D digital image around a predetermined portion of the internal anatomy of the person;

the computer being further configured to perform a maximum intensity projection of the predetermined portion of the first 3-D digital image to obtain a second 3-D digital image; and

the computer being further configured to combine the first 3-D digital image and the second 3-D digital image to obtain the resultant 3-D digital image.

38. The system of claim 37, wherein the resultant 3-D digital images comprises a first region having a first plurality of voxel intensity values indicative of locations of a tumor during at least one respiratory cycle and a second region having a second plurality of voxel intensity values indicative of the internal anatomy surrounding the tumor, the first plurality of voxel intensity values being less than each of the second plurality of voxel intensity values.

39. The system of claim 37 wherein the computer is further configured to color code a portion of the resultant 3-D digital image, and to display the color-coded resultant 3-D digital image on a display monitor.

40. The system of claim 37, wherein the computer is further configured to display the resultant 3-D digital image on a display monitor using a volume rendering technique.

41. The system of claim 37, wherein the computer is further configured to store the resultant 3-D digital image in a memory.

42. The system of claim 26, wherein at least a portion of the internal anatomy of the person comprises a tumor.

43. The system of claim 26, wherein the plurality of cross-sectional digital images comprises a plurality of computerized tomography images.

44. The system of claim 26, wherein the plurality of cross-sectional digital images comprises magnetic resonance images.

45. The system of claim 26, wherein the plurality of 3-D digital images comprises a plurality of 3-D computerized tomography images.

46. The system of claim 26, wherein the computer is further configured to display at least a portion of the resultant 3-D digital image on a display monitor.

47. The system of claim 26, wherein the computer is further configured to display a 2-D portion of the resultant 3-D digital image on a display monitor.

48. The system of claim 26, wherein the computer is further configured color code a portion of the resultant 3-D digital image and to display the color-coded resultant 3-D digital image on a display monitor.

49. The system of claim 48, wherein the color-coded resultant 3-D digital image is generated using a volume rendering display function.

50. An article of manufacture, comprising:

a computer storage medium having a computer program encoded therein for generating a digital image indicative of an internal anatomy of a person over a respiratory cycle, the computer storage medium comprising:

code for inducing a scanning device to scan the internal anatomy of the person at a plurality of positions along an axis to obtain scanning data, wherein the scanning at each position is performed over at least one respiratory cycle of the person;

code for generating a plurality of cross-sectional digital images based on the scanning data;

code for generating a plurality of cross-sectional digital image groups, each group comprising at least two digital images of the plurality of cross-sectional digital images wherein each of the two digital images indicate the internal anatomy at a substantially similar respiratory state;

code for generating a plurality of 3-D digital images, wherein each digital image of the plurality of 3-D digital images is determined from a corresponding one of the plurality of cross-sectional digital image groups; and

code for processing the plurality of 3-D digital images to obtain a resultant 3-D digital image indicating positions of at least a portion of the internal anatomy of the person during at least the respiratory cycle.